CLAIMS

We Claim:

1. In a building that has an electrical load and that carries a solar powered electrical supply comprising an array of photovoltaic cells having a predetermined factory performance rating, apparatus comprising:

(a) irradiance means, in solar communication with the array, for producing a signal representative of solar irradiance;

(b) a circuit, carried by the building and having a clock, for computing a running performance signal by using at least the predetermined performance rating, and said irradiance signal, and a measure of the electrical power supplied to the load from the array;

(c) a radio for broadcasting said performance signal, and,

(d) a generally portable unit for receiving said performance signal from said radio and for visually displaying said performance signal.

2. The apparatus of Claim 1, wherein said solar powered electrical supply is characterized by an outdoor temperature; and wherein said circuit computes said running performance signal by using said irradiance signal, the predetermined performance rating, and outdoor temperature,

3. The apparatus of Claim 1, wherein said running performance signal is a function of the difference between a pre-determined number, and a number whose value is derived from a signal representing solar irradiance.

4. The apparatus of Claim 3, where said difference is greater than 50%.

5. The apparatus of Claim 3, wherein said portable unit emits light when said difference is greater than a predetermined amount during the time when sunlight is expected.

6. The apparatus of Claim 5, wherein said light is emitted by a liquid crystal display

7. The apparatus of Claim 1, wherein said irradiance means comprises a solar cell having a predetermined electrical output as a function of its temperature; wherein said irradiance signal is transmitted by said radio; and wherein said portable unit comprises a lighted display that is a function of said irradiance signal.

8. The apparatus of Claim 1, wherein said running performance signal is a function of the difference between:

(a) a signal representative of electrical power supplied to the load from the array; and

(b) a signal representative of a calculation of the electrical power the array should produce as a function of time, said predetermined factory photovoltaic performance rating, and irradiance.

9. The apparatus of Claim 1, wherein said irradiance means is selected from the group consisting of silicon photodiode, a pyranometer, and a photoelectric cell.

10. The apparatus of Claim 1, wherein said running performance signal is a function of:

(a) the difference between electrical power supplied to the load from the array and what electrical power said array should produce as a function of current time, said predetermined factory photovoltaic performance rating, and said irradiance, and

(b) a predetermined maximum difference signal.

11. The apparatus of Claim 1, where said performance signal is visually displayed on said portable unit by means of liquid crystal display that indicates if said difference is less than or equal a predetermined amount.

12. The apparatus of Claim 1, wherein said performance signal is computed at least every 15 minutes during day time.

13. The apparatus of Claim 1, wherein said running performance signal is a function of the difference between a number whose value is derived from a signal representing electrical power supplied to the load from the array, and a number whose value is derived from a signal representing solar irradiance and a signal representing ambient temperature.

14. The apparatus of Claim 1, wherein said running performance signal is a function of a number whose value is derived from a signal representing solar irradiance and a signal representing ambient temperature.

15. The apparatus of Claim 1, wherein said radio broadcasts a power signal representative of said measure of the electrical power supplied to the load from the array; and further including a display, operating in response to said power signal and located on said portable unit, of electrical power from the array.

16. The apparatus of Claim 1, wherein said radio broadcasts said irradiance signal, and said portable unit displays a solar irradiance.

17. The apparatus of Claim 15, wherein said load is connected to an electrical service supply; further including means for providing a measure of the electrical power supplied to said load by said service supply; and wherein said radio broadcasts said measure of electrical power supplied to said load by said service supply; and further including a display on said portable unit of electrical power consumed by the load from said electrical service.

18. The apparatus of Claim 17, wherein said circuit derives the percentage of power consumed by the load and provided by the array relative to power consumed by the load and provided by said electrical service.

19. The apparatus of Claim 16, wherein said display of solar irradiance is a depiction of the percent of measured solar irradiance relative to maximum solar irradiance.

20. The apparatus of Claim 16, wherein said display of solar irradiance is depicted by N icons, where "N" is a whole number, and where each icon represents about (100%)/N of maximum solar irradiance.

21. The apparatus of Claim 18, wherein said electrical power provided by the array is displayed as a function of time.

22. The apparatus of Claim 18, wherein said electrical power provided by the array is depicted as total watt-hours consumed.

23. The apparatus of Claim 18, wherein said electrical power provided by the array is depicted as total watt-hours produced during the current day.

24. The apparatus of Claim 22, wherein electrical power provided by the array is depicted as a percent of maximum array capacity.

25. Apparatus, comprising:

(a) a generally fixed unit that is adapted to be carried by a building to which an electrical utility supplies electricity to a load, said building having a roof carrying photovoltaic cells supplying electricity to the load, and an outdoor temperature, said unit being adapted to receive a first signal that is representative of electrical power consumed by said load and provided by the utility, a signal that is representative of photovoltaic electrical power consumed by said load, a first signal that is representative of said outdoor temperature, a second signal that is representative of solar irradiance on said roof, and a time signal that is representative of time; a circuit within said unit using at least said first and said second representative signals and time to derive a signal that is representative of expected power output of said photovoltaic cells, said unit including a relatively short range radio for broadcasting information that is representative of at least said derived signal: and

(b) a substantially movable unit for receiving information broadcasted from said radio and for visually displaying at least a representation of photovoltaic power consumption and a representation of said derived signal.

26. The apparatus of Claim 25, wherein said movable unit includes a display of the photovoltaic power relative to utility provided electrical power, and said display operates in response to information broadcast by said radio.

27. The apparatus of Claim 25, wherein said movable unit includes a display of photovoltaic power on a time scale, wherein said radio broadcast information is a function of said solar irradiance.

28. The apparatus of Claim 27, wherein said movable unit includes a display of solar irradiance that is a function of time.

29. A monitor for a structure that is carried by the earth, that has a photovoltaic electrical supply on its exterior, that is adapted to receive a primary electrical supply, that has an electrical load adapted to be connected to the primary power supply and to the photovoltaic power supply, and that has an exterior temperature, comprising:

(a) a generally stationary unit comprising:

(i) photovoltaic means, operatively connected to the photovoltaic electrical supply, for producing a signal representative of photovoltaic power consumed by the load;

(ii) irradiance means, located on the exterior of the structure, for producing a signal representative of solar irradiance relative to the photovoltaic electrical supply;

(iii) circuitry, receiving signals representative of the outdoor temperature, solar irradiance and time, for repeatedly producing a signal representative of the expected photovoltaic electrical power output;

(iv) a circuit for producing an output signal that is a function of the difference between said expected photovoltaic electrical power output and actual photovoltaic electrical power consumption; and

(v) a radio to broadcast information that is a function of photovoltaic electrical power output, said irradiance signal and said output signal; and

(b) a generally movable unit for receiving said information from said radio means and for visually displaying photovoltaic electrical power consumption, solar irradiance, and said output signal.

30. The monitor of Claim 29, wherein said stationary unit receives a signal representative of the primary power consumption and sends it to said radio means; and wherein said movable unit displays primary power consumption in digital form,

31. The monitor of Claim 29, wherein said movable unit displays in digital form photovoltaic power consumption as a function of time.

32. The monitor of Claim 29, wherein said movable unit displays as a step function photovoltaic power consumption.

33. The monitor of Claim 29, wherein time is provided to said computation means by a clock; and wherein said circuitry includes a memory for storing signals representative of the photovoltaic electrical power consumption, outdoor temperature, said output signal, and time from said clock.

34. The monitor of Claim 29, wherein said radio receives said signal representative of outdoor temperature, and said movable unit displays outdoor temperature.

35. The monitor of Claim 29, wherein said radio receives a signal representative of primary power consumption, and said movable unit displays primary power consumption.

36. The monitor of Claim 29, wherein said movable unit displays in digital form primary power consumption, said photovoltaic power output; and photovoltaic power output as a function of time.

37. The monitor of Claim 29, wherein said irradiance means comprises a solar cell.

38. An energy monitor adapted for use in home having an electrical load and a roof that carries a solar electrical power supply, comprising:

(a) first power means, connected to the home's solar electrical power supply, for producing signals representative of power consumed by the load from said solar electrical power supply;

(b) irradiance means for producing a signal representative of solar irradiance;

(c) circuitry, utilizing time and said signal representative of power consumed by the load from said solar power supply and said solar irradiance signal, for producing an output signal representative of the efficiency of said solar electrical power supply;

(d) a radio transmitter for broadcasting information representative of the signals produced by said first power means and said circuitry; and

(e) a portable display, spaced apart from said radio transmitter, for receiving information from said radio transmitter and for visually displaying generated power consumption, solar power consumption, solar irradiance, and ameasure of said efficiency of said solar power supply.

39. The energy monitor of Claim 38, further including second power means connected to the homes utility service for producing, as an output, signals representative of power consumed by the load from said utility service.

40. The energy monitor of Claim 39, wherein said signals representative of power consumed by the load from said utility service are sent to said radio transmitter and received by said portable display for display thereon.

41. The energy monitor of Claim 40, wherein said circuitry and said radio transmitter are housed together.

42. The energy monitor of Claim 41, wherein said circuitry comprises a clock providing digital time signals; and memory, operatively connected to said clock to store said output signal and solar electrical power consumption signals in the form of a time log.

43. The energy monitor of Claim 42, wherein the solar electrical power supply comprises an array of photovoltaic cells characterized by a factory performance rating; and wherein said circuitry produces said output signal as a function of said said factory performance rating.

44. In a habitat that is carried by a platform orbiting a star, that has a photovoltaic electrical power supply on its exterior that has a source of primary electrical power supply; that has an electrical load adapted to be connected to the primary power supply and to the photovoltaic power supply, and that has an exterior temperature, apparatus, comprising:

(a) a substantially fixed unit that is adapted to receive:

(i) a signal representative of photovoltaic electrical power consumed by the load,

(ii) a signal representative of solar irradiance for the photovoltaic electrical power supply, and

(iii) a signal from a clock that is representative of time,

said fixed unit comprising a radio for transmitting information that is a function of signals (i) through (iii) and a signal that is representative of the expected performance of the photovoltaic electrical power supply and that is derived at least from signals (i) through (iii); and

(b) a receiver that is substantially movable for receiving said information from said radio and for visually displaying representations of time, photovoltaic electrical power consumption, and said performance signal.

45. The apparatus of Claim 44, wherein said photovoltaic power supply comprises an array of photovoltaic cells; and further including means, located in the vicinity of said array for providing a signal representative of solar irradiance.

46. The apparatus of Claim 44, further including a visual display carried by the receiver, and a signal comparator carried by the receiver and operatively connected to the visual display such that if the radio signal from the base unit drops

below a predetermined signal strength, said visual display is energized.

47. In a building that has an electrical load and that carries a solar powered electrical supply comprising an array of photovoltaic cells for producing electrical power to the load, apparatus comprising:

(a) a first power sensor, operatively connected to the output of the solar powered electrical supply, for producing a signal representative of the electrical power being produced from the array;

(b) a radio, operatively connected to said first power sensor, for broadcasting a signal that is representative of said power signal; and

(c) a generally portable unit for receiving said power signal from said radio and for visually displaying a representation of the electrical power being produced from the array.

48. The apparatus of Claim 47, wherein said array has a predetermined performance rating; and further including:

(d) an irradiance sensor, in solar communication with the array, for producing a signal representative of solar irradiance; and

(e) a circuit, carried by the building, for deriving a running performance signal by using at least the predetermined performance rating of the array and said irradiance signal and said signal representative of the electrical power being produced;

wherein said radio is operatively connected to said circuit to broadcast said performance signal; and wherein said portable unit comprises means for receiving said performance signal from said radio and for visually displaying said performance signal.

49. The apparatus of Claim 47, further including:

(d) an irradiance sensor, in solar communication with the array, for producing a signal representative of solar irradiance,

wherein said radio is operatively connected to said irradiance senser to broadcast said signal that is a function of said irradiance signal; and wherein said portable unit comprises means for receiving said irradiance signal from said radio and for visually displaying solar irradiance.

50. The apparatus of Claim 49, wherein said irradiance signal is displayed by using at least two intensity icons, both of which are lighted when the irradiance signal is maximum, none of which are lighted when the irradiance signal is below a first predetermined minimum, and one of which is lighted when said irradiance signal is at least equal to a second predetermined minimum.

51. The apparatus of Claim 47, wherein the load in the building is connected to an external electrical supply; and further including:

(d) a second power sensor, operatively connected to said external electrical supply, for producing a signal representative of the electrical power supplied to the building; and

(e) a circuit, connected to said first power sensor and to said second power sensor, for deriving a signal that is representative of the total electrical power the building is using,

wherein said radio is operatively connected to said circuit to broadcast a signal that is a function of the total electrical power the building is using; and wherein said portable unit comprises means for receiving said total electrical power signal from said radio and for visually displaying said total electrical power the building is using.

52. The apparatus of Claim 47, wherein the load in the building is connected to an external electrical supply further including:

(d) a second power sensor, operatively connected to said external electrical supply, for producing a signal representative of the electrical power supplied to the building; and

(e) a circuit, connected to said first power sensor and to said second power sensor, for deriving a signal that is representative of the percentage of the total electrical power the building is using that is provided by the array,

wherein said radio is operatively connected to said circuit to broadcast a signal that is a function of said percentage of the total electrical power the building is using that is provided by the array; and wherein said portable unit comprises means for receiving said percentage of the total electrical power signal from said radio and for visually displaying said percentage of the total electrical power that is provided by the array.

53. The apparatus of Claim 47, further including:

(d) a clock;

(e) memory; and

(f) a circuit operatively connected to said clock and said first power sensor for storing in memory a representation of the amount of energy (kWh) the solar array produced over a calendar day,

wherein said radio is operatively connected to said memory to broadcast a signal that is a function of said daily solar power production; and wherein said portable unit comprises means for receiving said daily solar power production signal from said radio and for visually displaying said daily solar power production.

54. The apparatus of Claim 47, wherein the load in the building is connected to an external electrical supply, further including:

(d) a clock;

(e) memory;

(f) a second power sensor, operatively connected to said external electrical supply, for producing a signal representative of the electrical power supplied to the building; and

(g) a circuit, connected to said first power sensor, to said clock and to said second power sensor, for storing in memory a representation of the percentage of the total electrical energy the building is using that is provided by the array over one day,

wherein said radio is operatively connected to said circuit to broadcast a signal that is a function of said percentage of the total electrical energy the building is using that is provided by the array each day; and wherein said portable unit comprises means for receiving said daily percentage of the total electrical energy signal from said radio and for visually displaying said daily percentage of the total electrical energy that is provided by the array.

55. The apparatus of Claim 47, further including:

(d) a clock, and

(e) memory,

wherein said signal representative of the electrical power being produced from the array is periodically sent into said memory and aggregated in response to said clock; wherein said radio is operatively connected to said memory to broadcast said aggregated electrical power signal; and wherein said portable unit comprises a means for receiving said aggregated electrical power signal, and a graphic representation of a day's solar electricity production as a function of time.

56. The apparatus of Claim 55, wherein said graphic representation of a day's solar electricity production is hourly for at least a portion of a day.

57. The apparatus of Claim 47, further including:

(d) a clock, and

(e) memory,

wherein said signal representative of the electrical power being produced from the array is periodically sent into said memory and aggregated in response to said clock; wherein said radio is operatively connected to said memory to broadcast said aggregated electrical power signals; and wherein said portable unit comprises a means for receiving said aggregated electrical power signal, and a display of solar electricity production over a plurality of days.

58. The apparatus of Claim 57, wherein said a display of solar electricity production over a plurality of days shows the cumulative energy (kWh) produced by the solar electric system since it was installed. .

59. In a building that has an electrical load connected to an external electrical supply, and that carries a solar powered electrical supply comprising an array of photovoltaic cells for producing electrical power to the load, apparatus comprising:

(a) a first power sensor, operatively connected to the output of the solar powered electrical supply, for producing a signal representative of the electrical power being produced from the array to the load;

(b) a second power sensor, operatively connected to the external electrical supply, for producing a signal representative of the electrical power supplied to the load from the external electrical supply;

(c) an irradiance sensor, in solar communication with the array, for producing a signal representative of solar irradiance;

(d) a first circuit, operatively connected to said first power sensor, for deriving a running performance signal by using at least said irradiance signal and said signal representative of the electrical power being produced;

(e) a second circuit, operatively connected to said first power sensor and to said second power sensor, for deriving a signal that is representative of the percentage of the total electrical power the building is using that is provided by the array;

(f) a radio, operatively connected to said first circuit and to said second circuit, to broadcast a signal that is representative of the percentage of the total electrical power that the building is using and that is provided by the array, and to broadcast said performance signal; and

(g) a generally movable unit for receiving signals from said radio, and visually displaying the percentage of the total electrical power that the building is using and that is provided by the array, and for visually displaying said performance signal.

60. In a building that has an electrical load connected to an external electrical supply, and that carries a solar powered electrical supply comprising an array of photovoltaic cells for producing electrical power to the load, apparatus comprising:

(a) a first power sensor, operatively connected to the output of the solar powered electrical supply, for producing a signal representative of the electrical power being supplied to the load from the array;

(b) a second power sensor, operatively connected to said external electrical supply, for producing a signal representative of the electrical power supplied to the load;

(c) an irradiance sensor, in solar communication with the array, for producing a signal representative of solar irradiance;

(d) a performance circuit for deriving a running performance signal by using at least said irradiance signal and said signal representative of the electrical power being produced from the array;

(e) a clock;

(f) memory;

(g) a computation circuit, operatively connected to said first power sensor, to said clock and to said second power sensor, for storing in memory data that represents the percentage of the total electrical energy supplied to the load that is provided by the array over one day,

(h) a radio, operatively connected to said performance circuit and to said memory, to broadcast signals that are representative of said data stored in memory and said performance signal; and

(i) a generally movable unit for receiving signals from said radio, and visually displaying said daily percentage of the total electrical energy that is provided by the array, and said running performance.